

# WFIRST

## Opportunities for Guest Observer Science

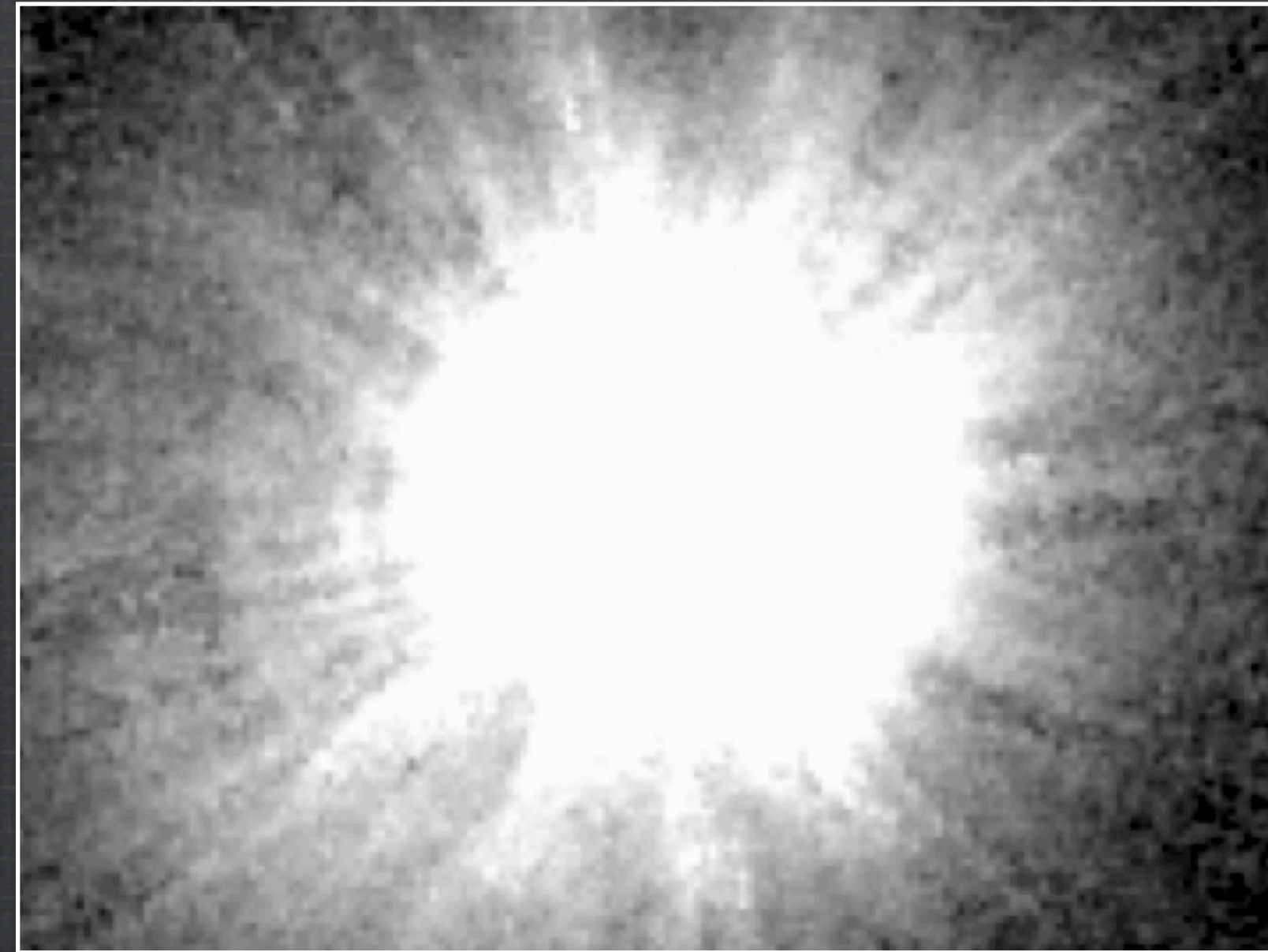


Jason Kalirai (STScI, JHU)

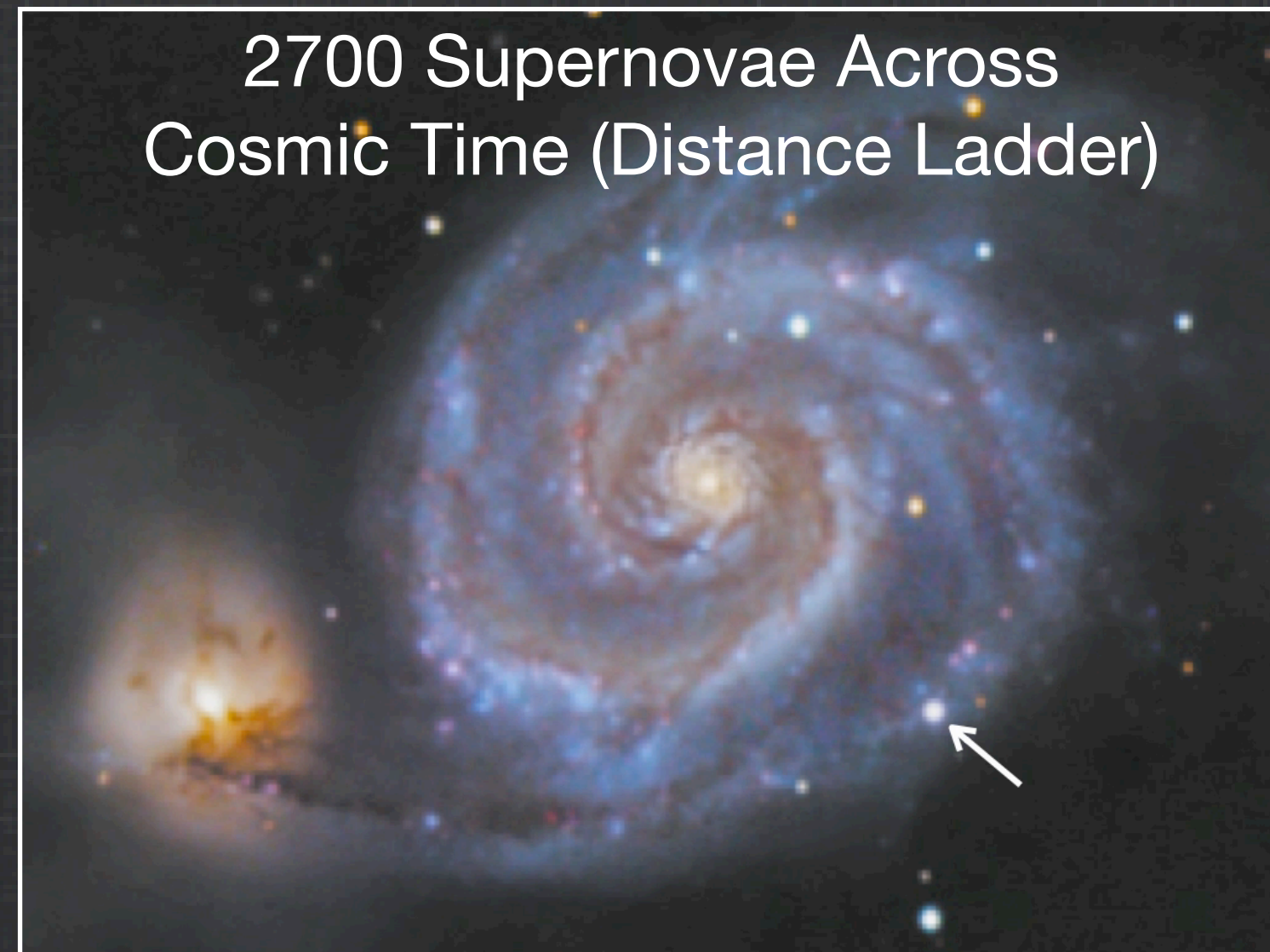


# A Snapshot of WFIRST Science

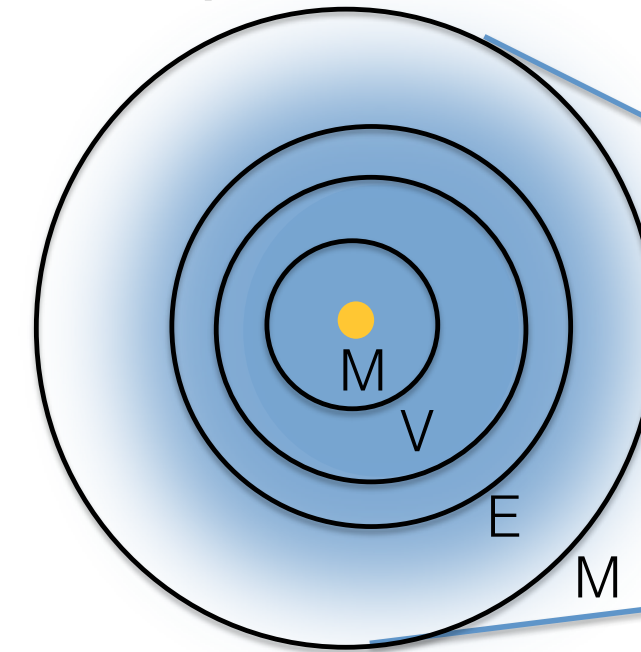
# Direct Space-Based Imaging of Exoplanets



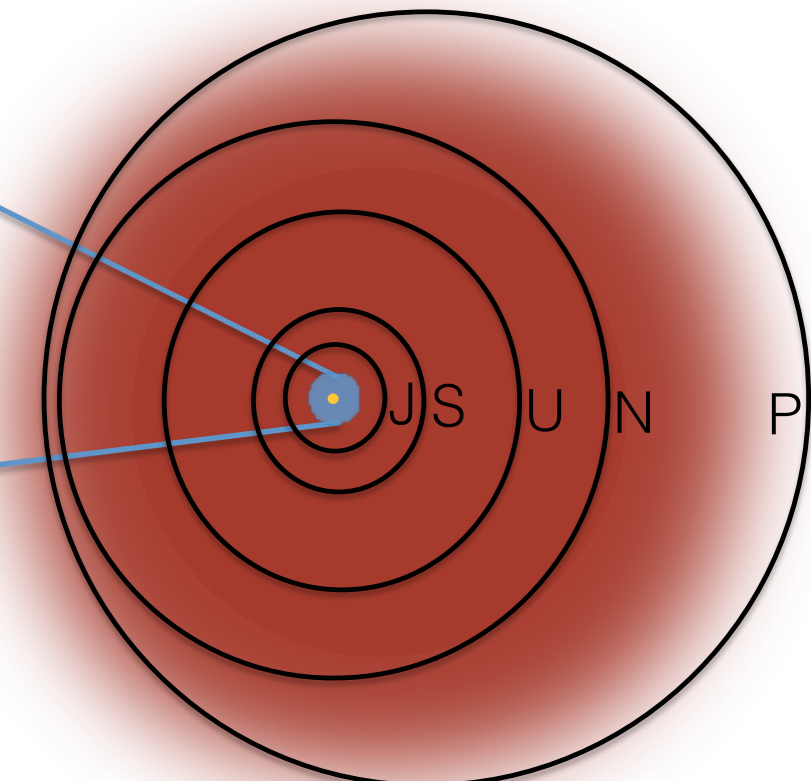
# 2700 Supernovae Across Cosmic Time (Distance Ladder)



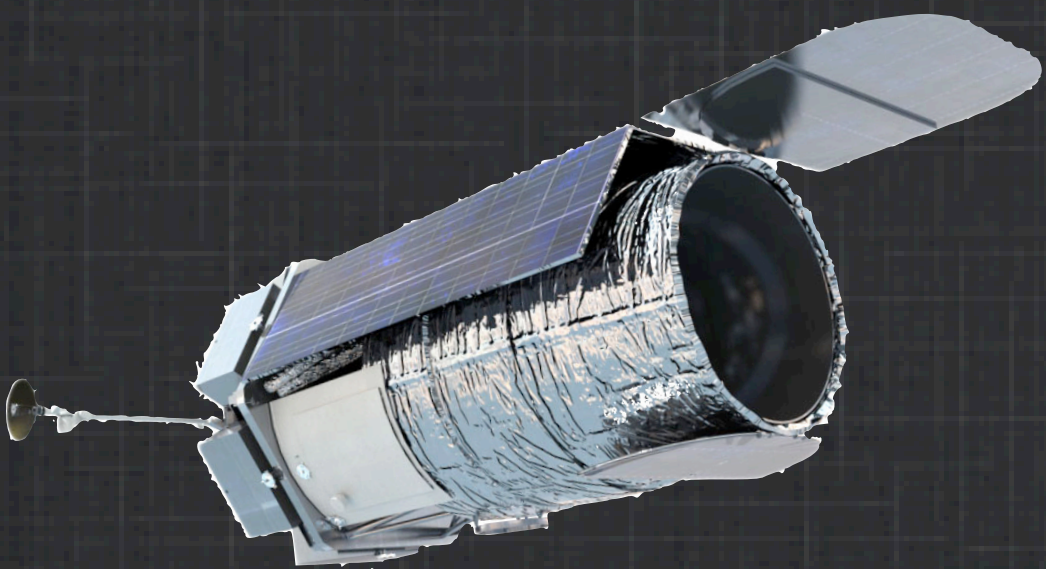
## Kepler Search



## WFIRST Search



## 2800 planets outside of Kepler's Search Volume

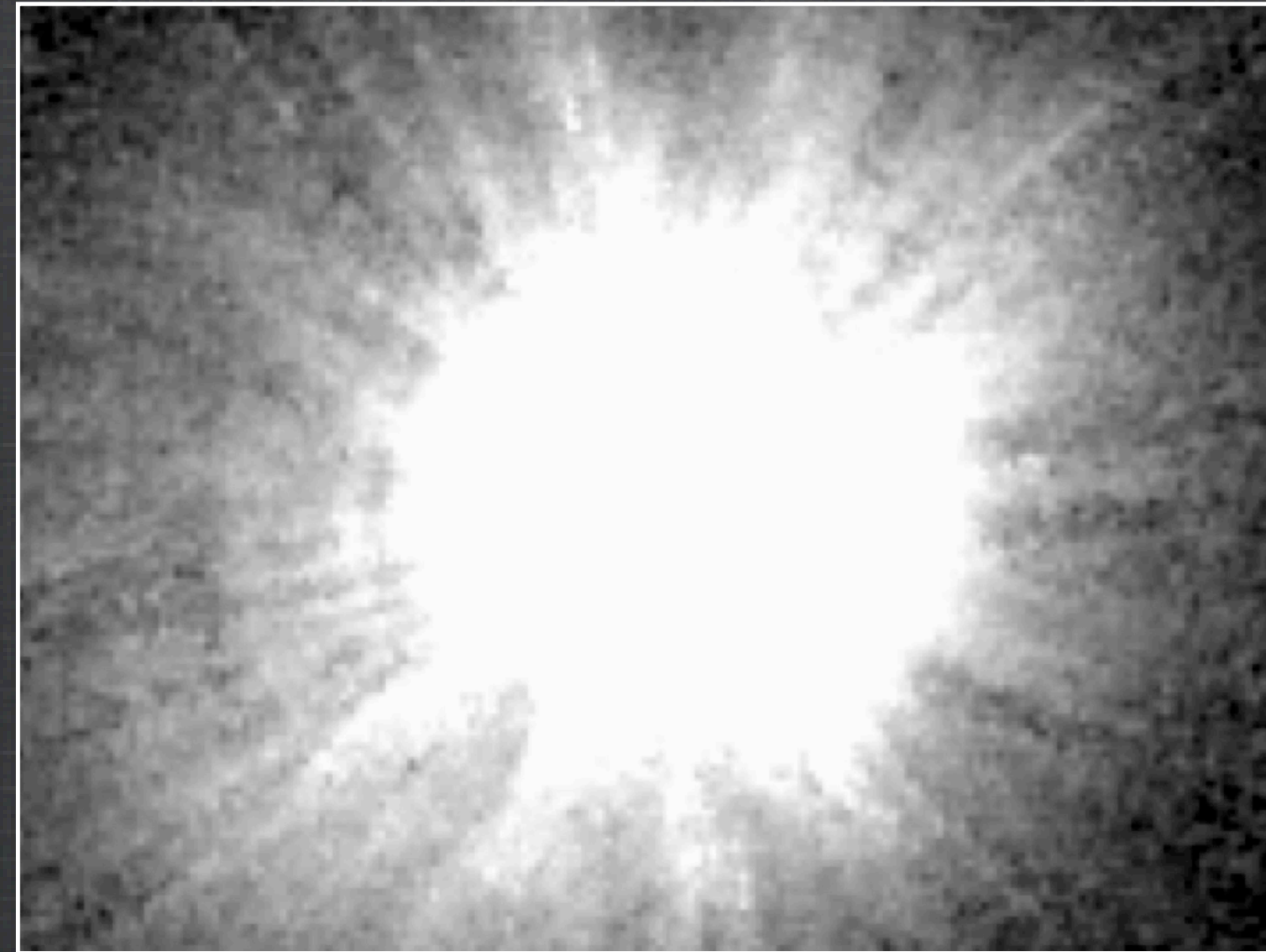




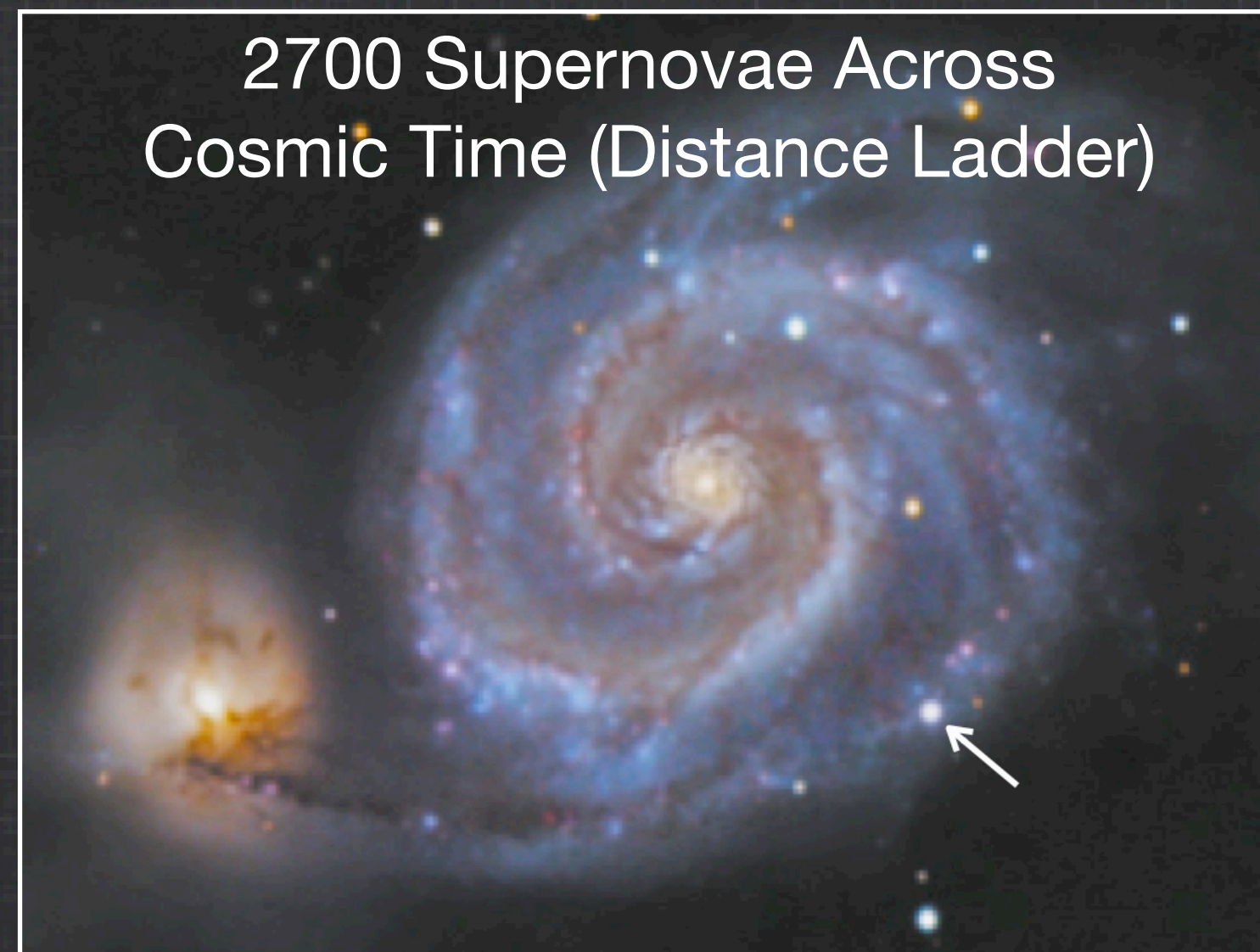
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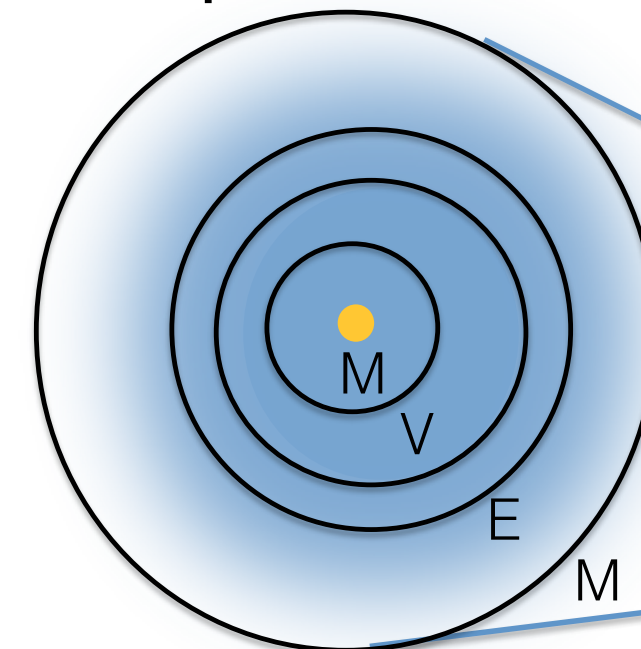
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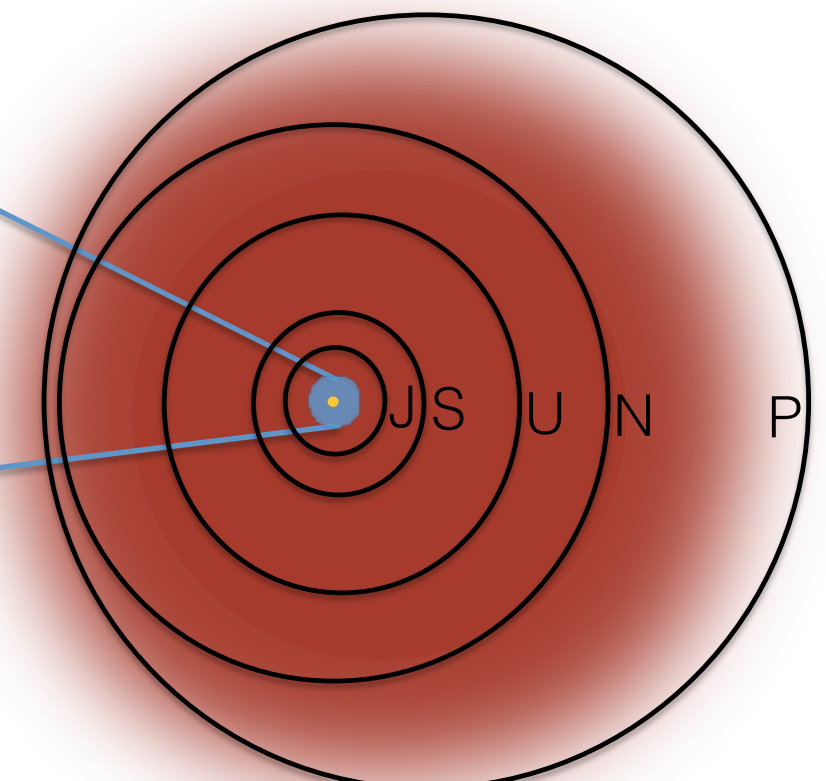
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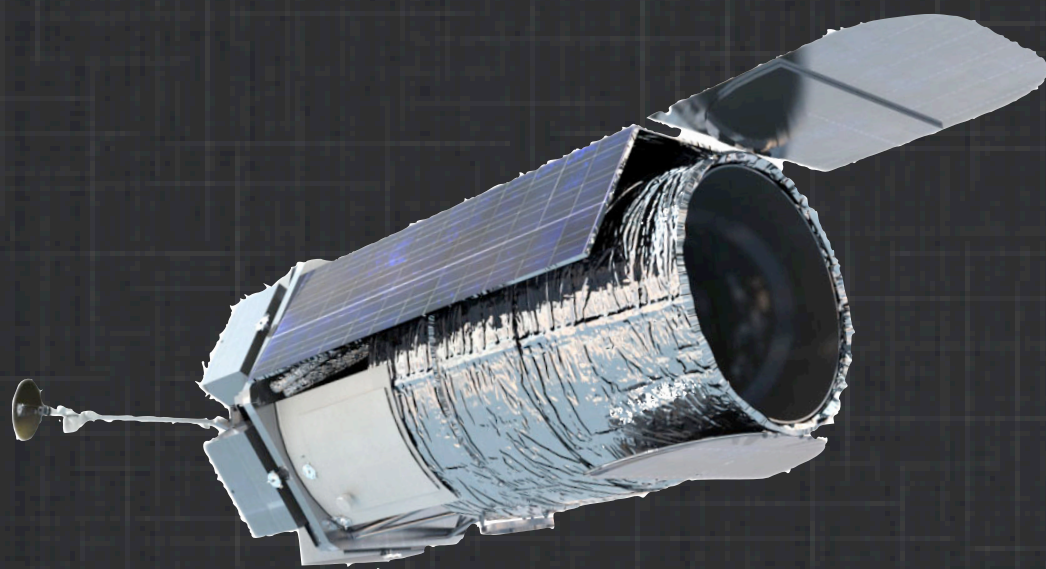
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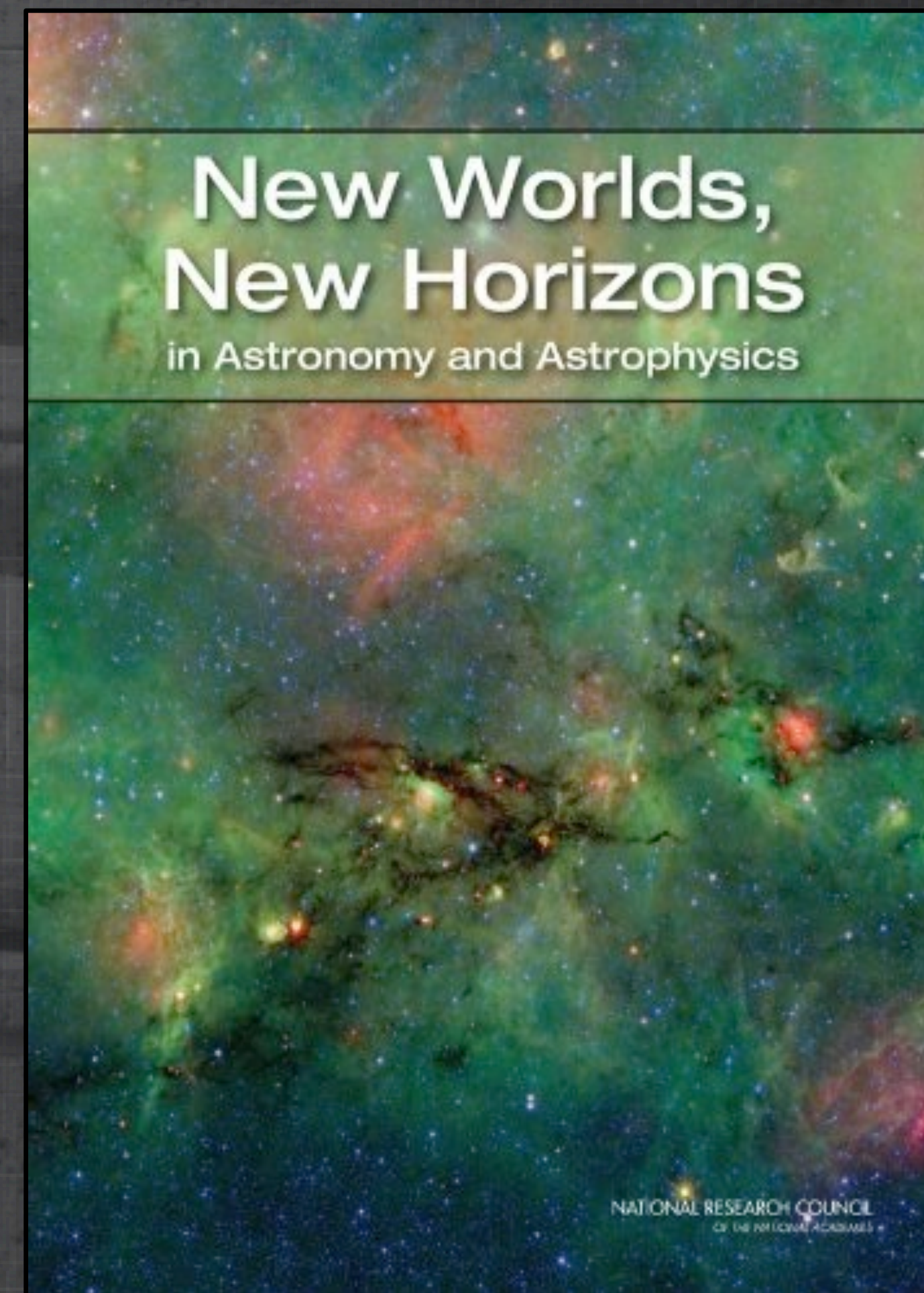
# The Guest Observer Program has Always Been a Part of the WFIRST Foundation

## Panel Reports - New Worlds, New Horizons in Astronomy and Astrophysics

*“A significant fraction of the first 5 years will also be used for surveys and smaller peer-reviewed guest-observer projects that will investigate, for example, galaxy evolution, stellar populations of nearby galaxies, and the plane of the Milky Way galaxy”*

*“The combination of depth, area, and quality of WFIRST data in the infrared will easily surpass that any other ground-based or space-based facility. WFIRST research bears substantially on 10 of the 20 key questions posed in the Astro2010 Science Frontiers Panel reports (see Table 6.2).”*

*“The ability of a single facility to have such broad impact, and its combination of affordability, technical readiness, and low risk, is why the EOS recommends WFIRST as the next large U.S. space mission.”*





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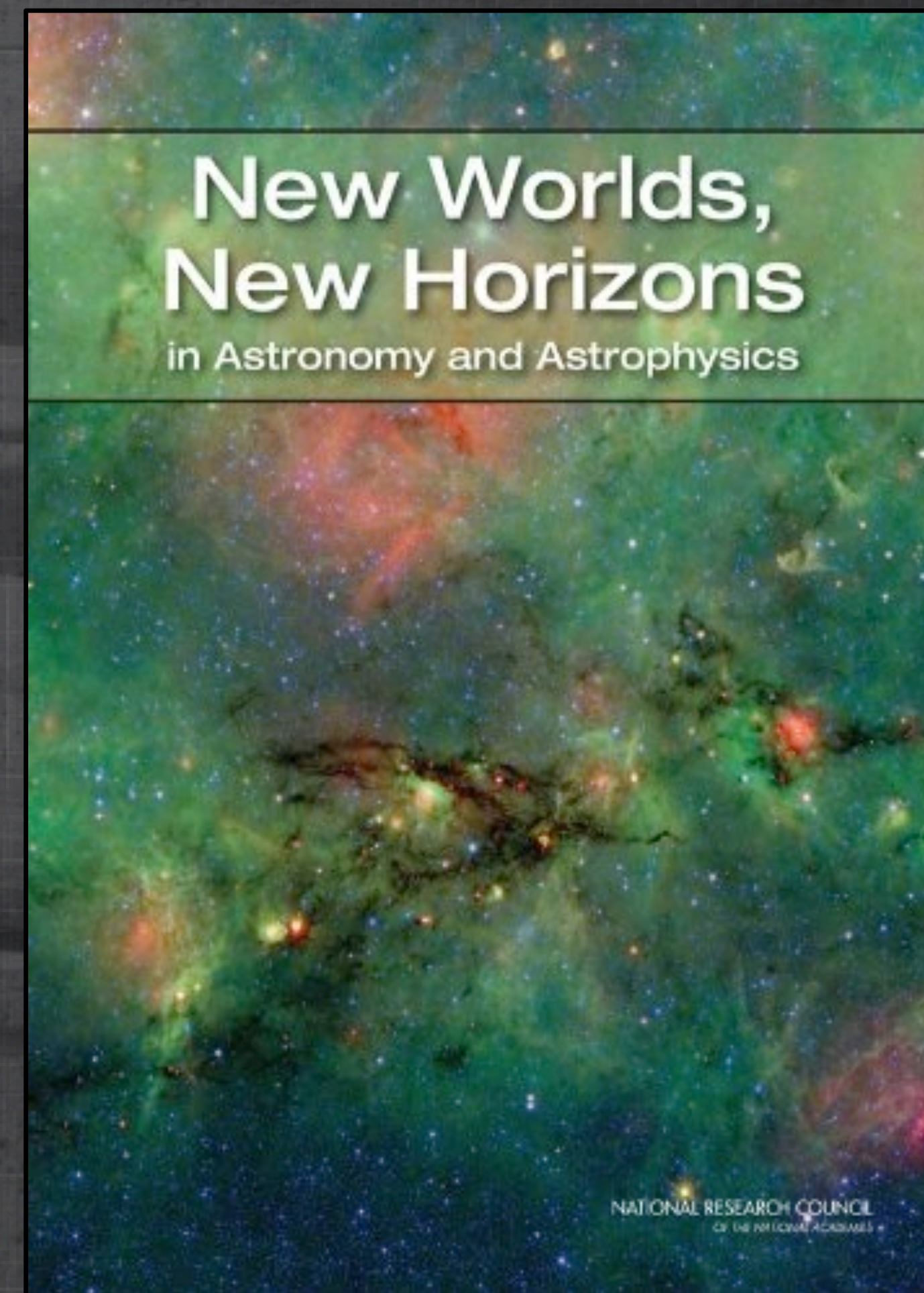
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...that was for a 1.5m telescope, not a 2.4m





# The Great Observatories

## A Successful Model for the Guest Observer Program

### Our Experience

- ★ Establishes broad **community engagement**
- ★ Tackles **diverse** set of astrophysical **questions** in changing paradigms
- ★ Open **competition** inspires **creativity**
- ★ Ensures long-term scientific **discovery potential**
- ★ For WFIRST, maximizes synergies with **JWST, Euclid, LSST, GSMTs** and other future facilities



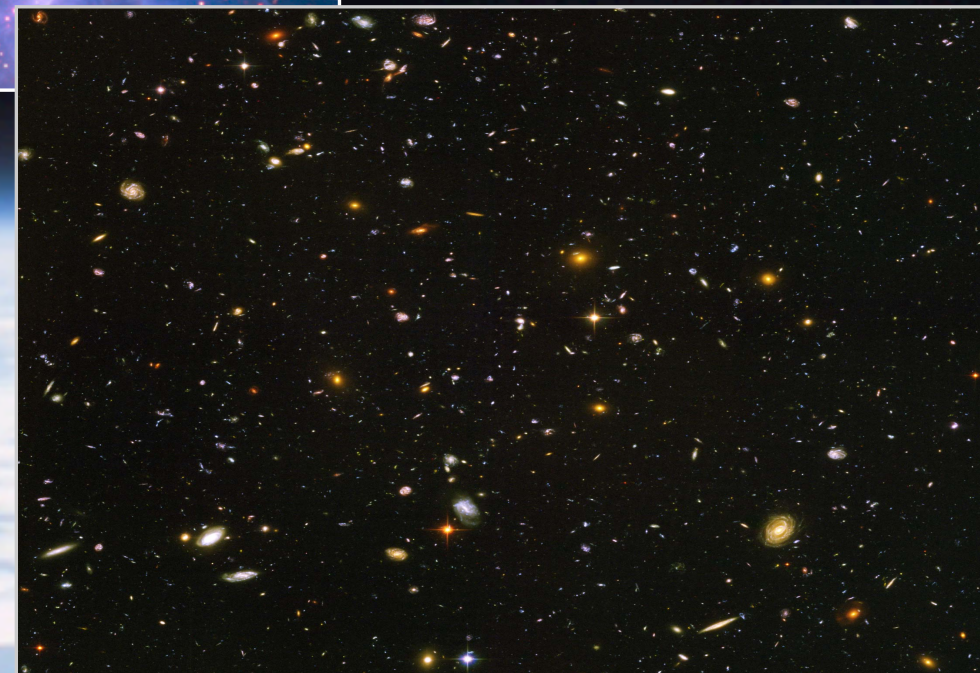
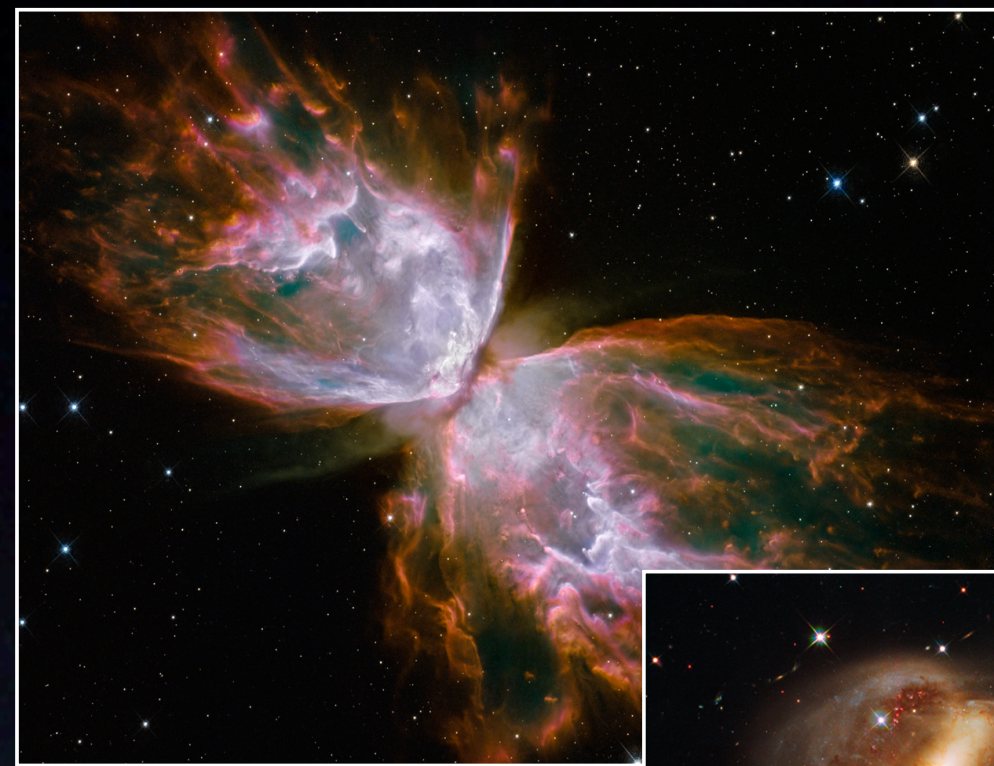


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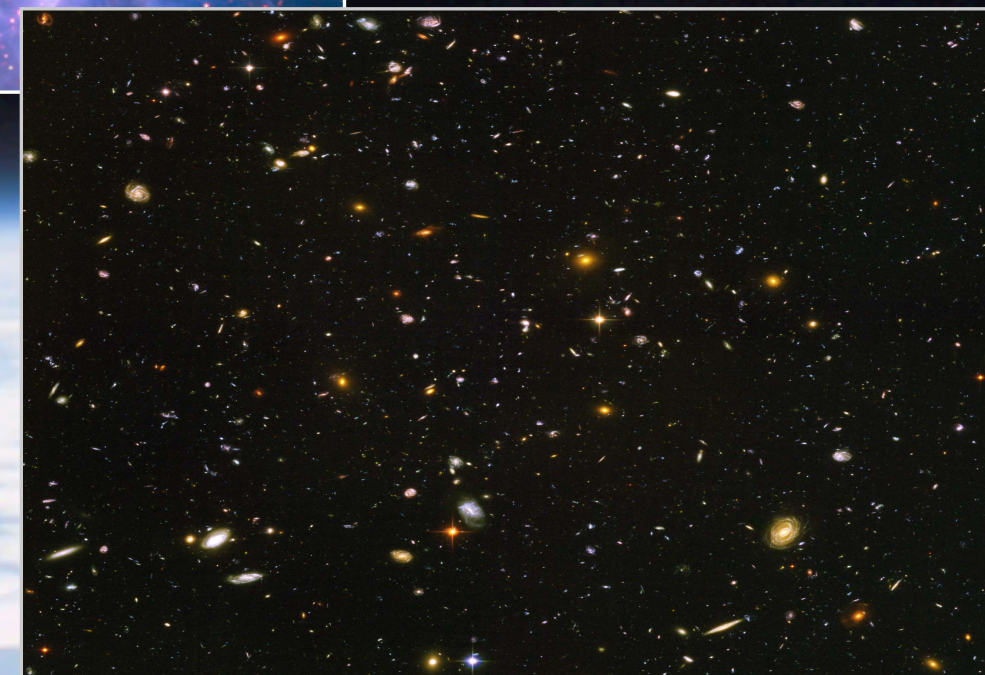
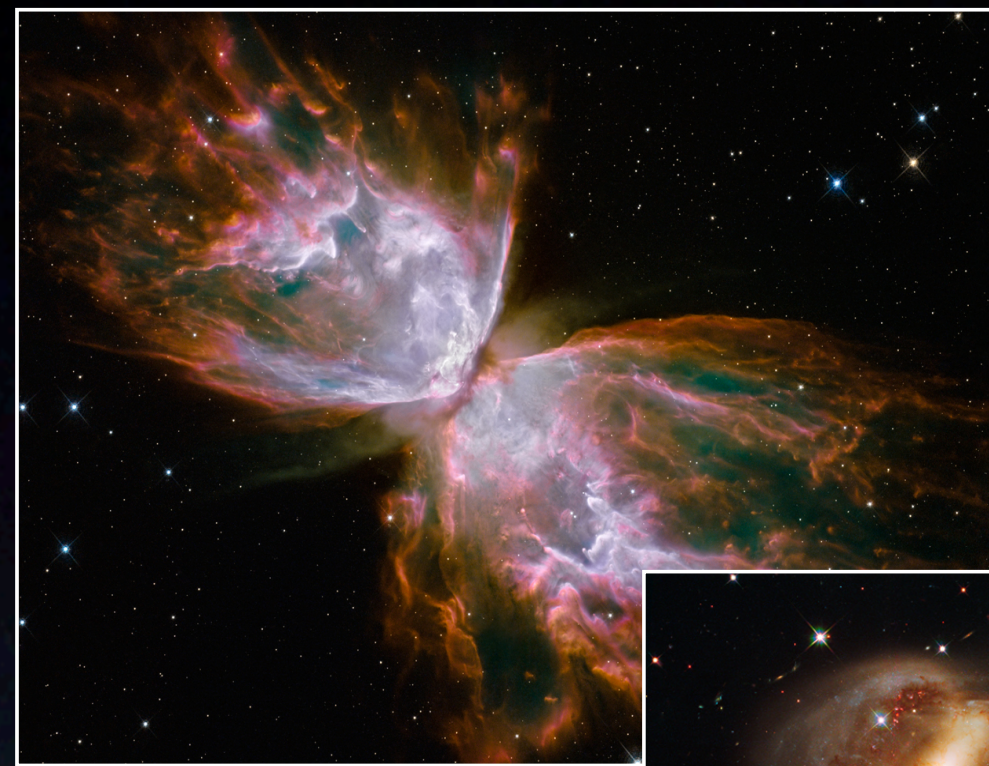
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**25% of WFIRST is budgeted for GO science**

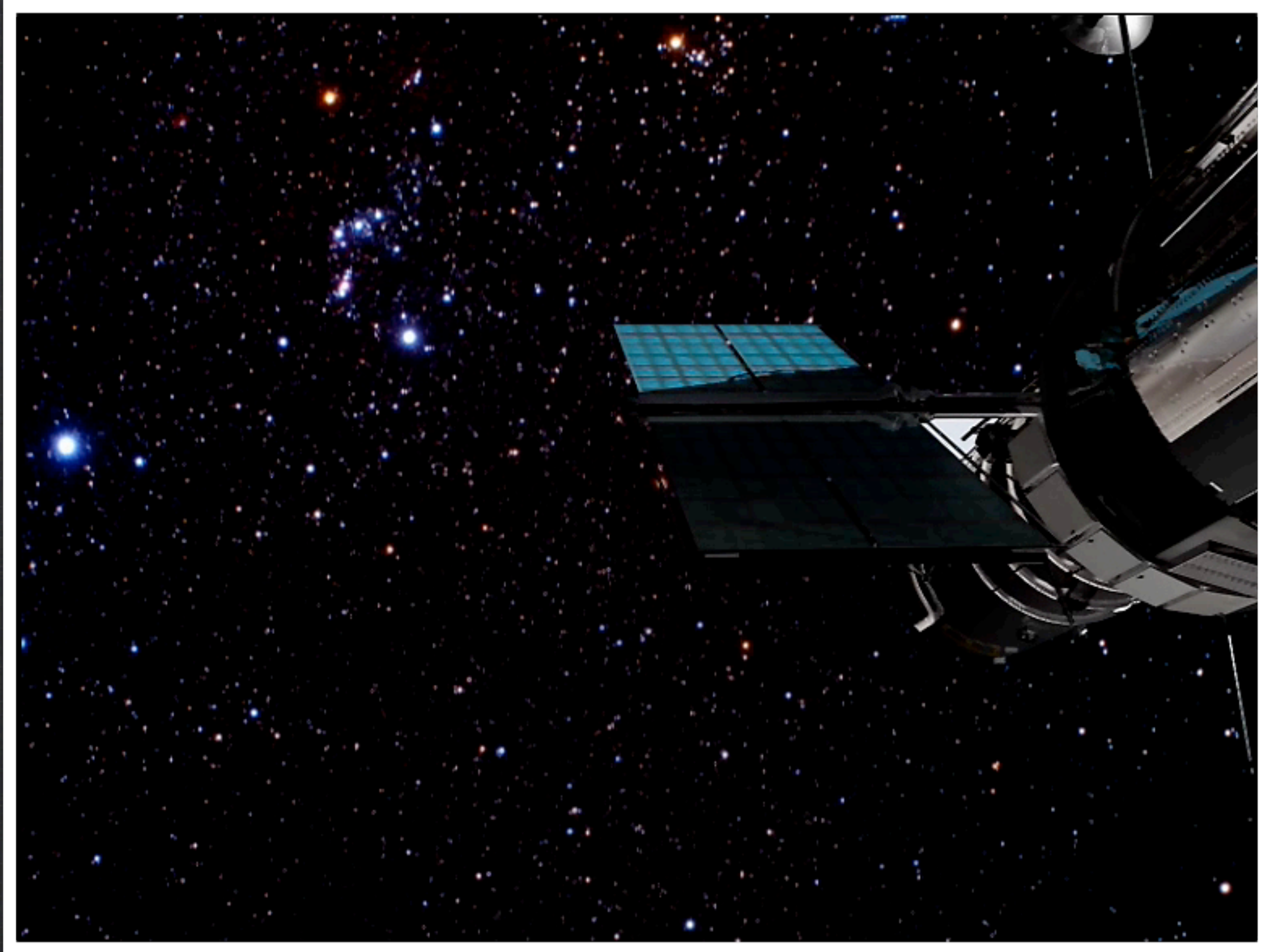




# The “Speed” of WFIRST is Unprecedented

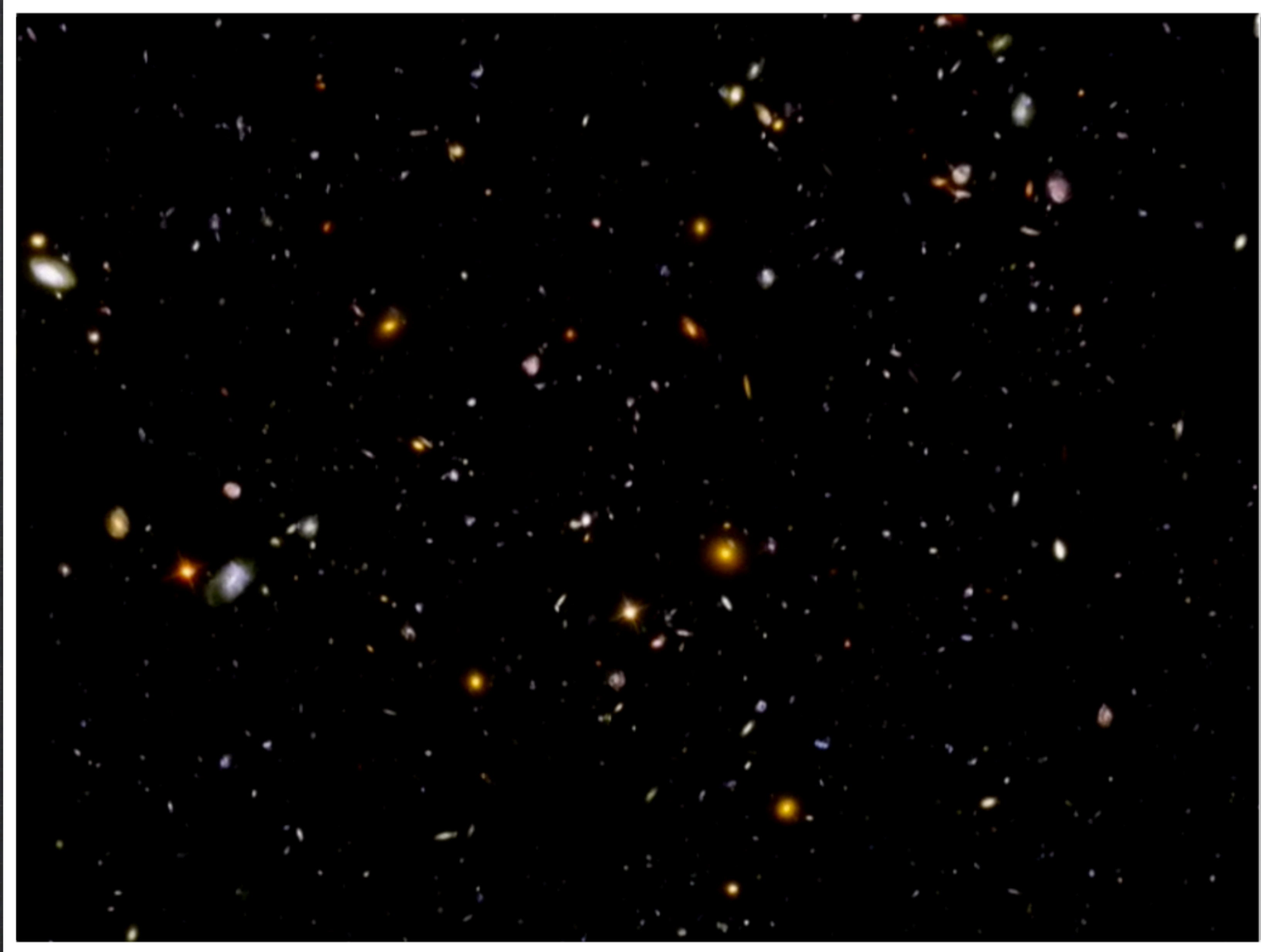


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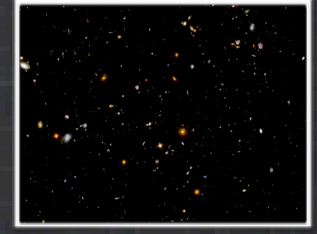


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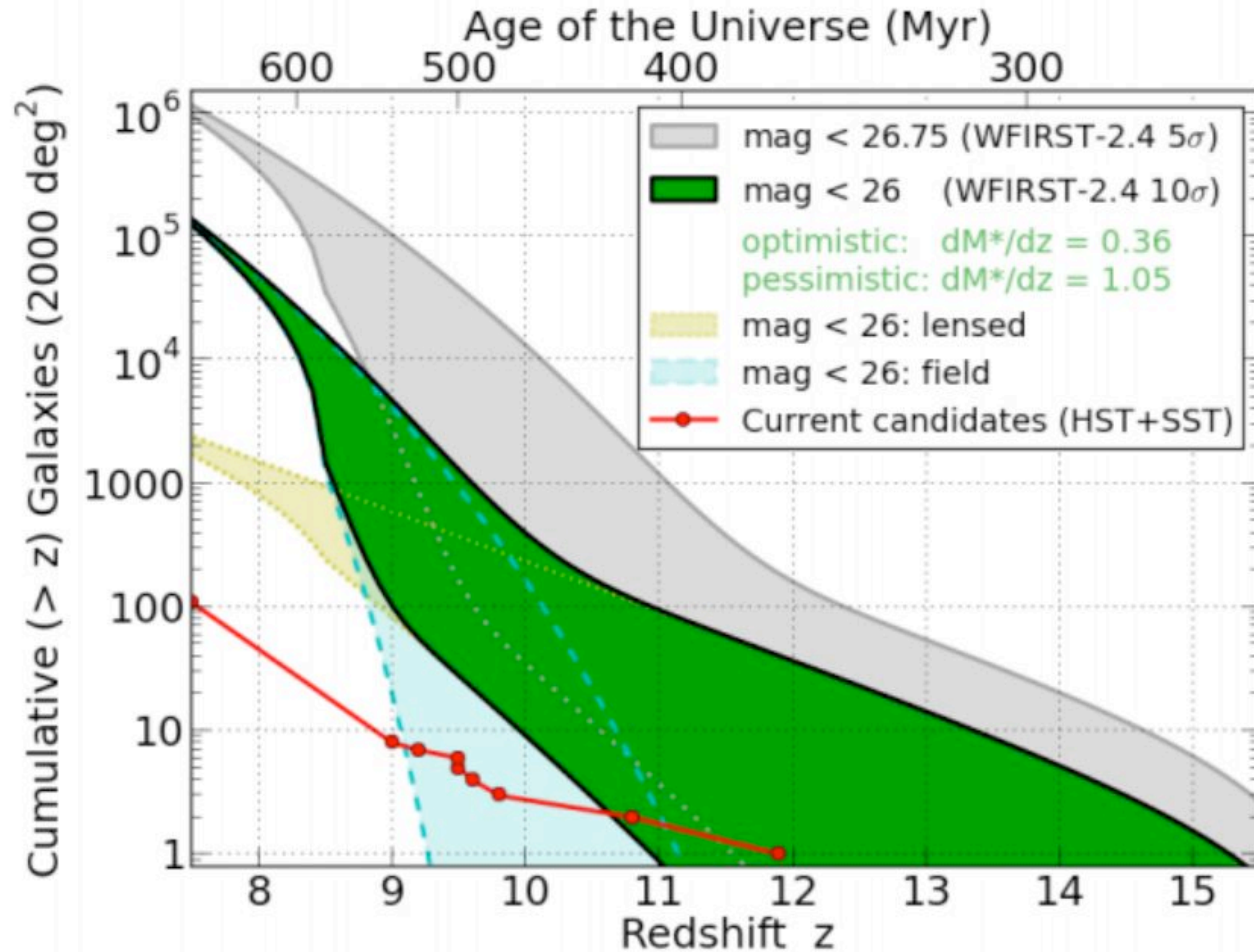
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A GO Program WFIRST Deep Field will measure  
1,000,000 galaxies at Hubble-resolution



# The WFIRST High-z Galaxy Luminosity Function





# Gravitational Lensing



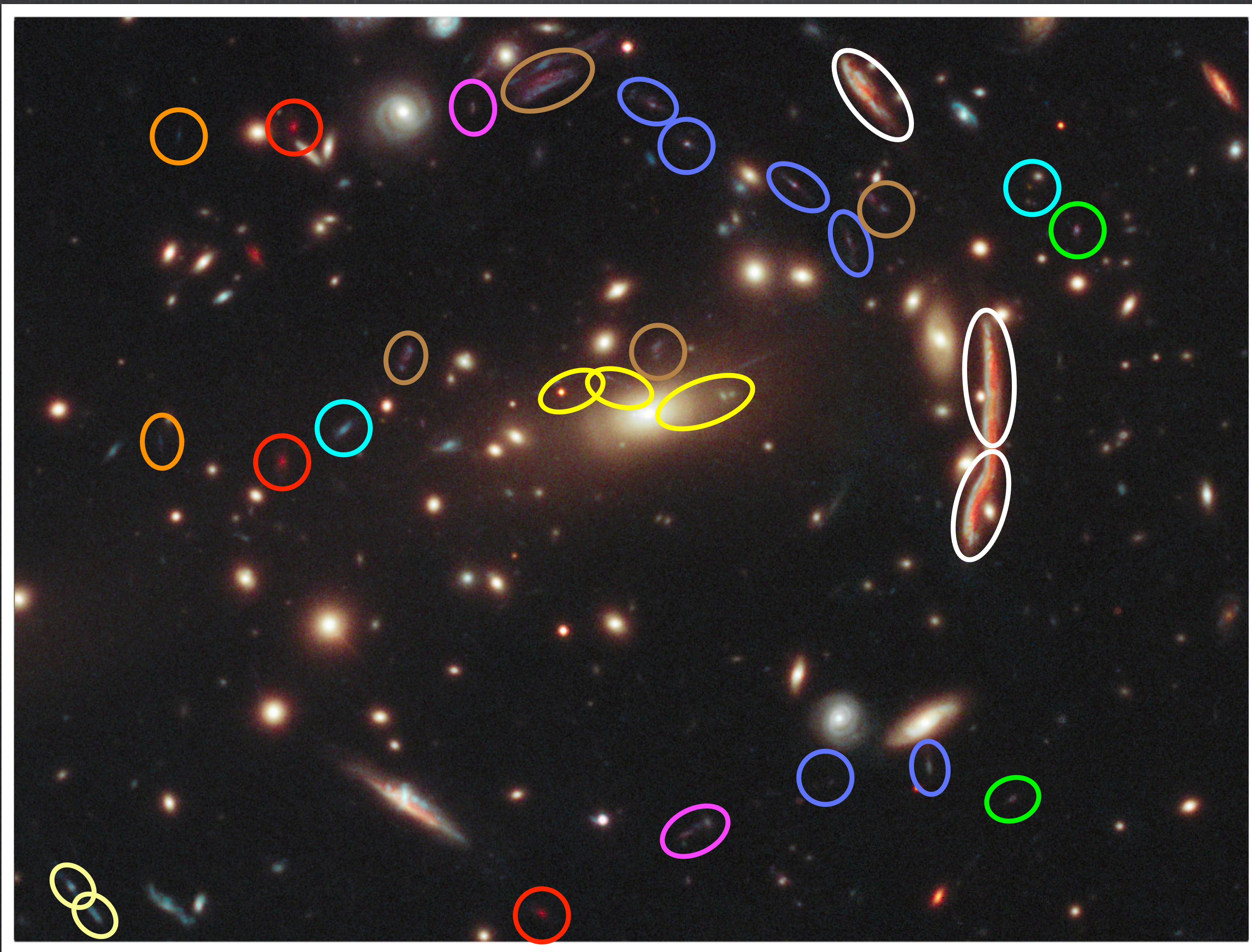


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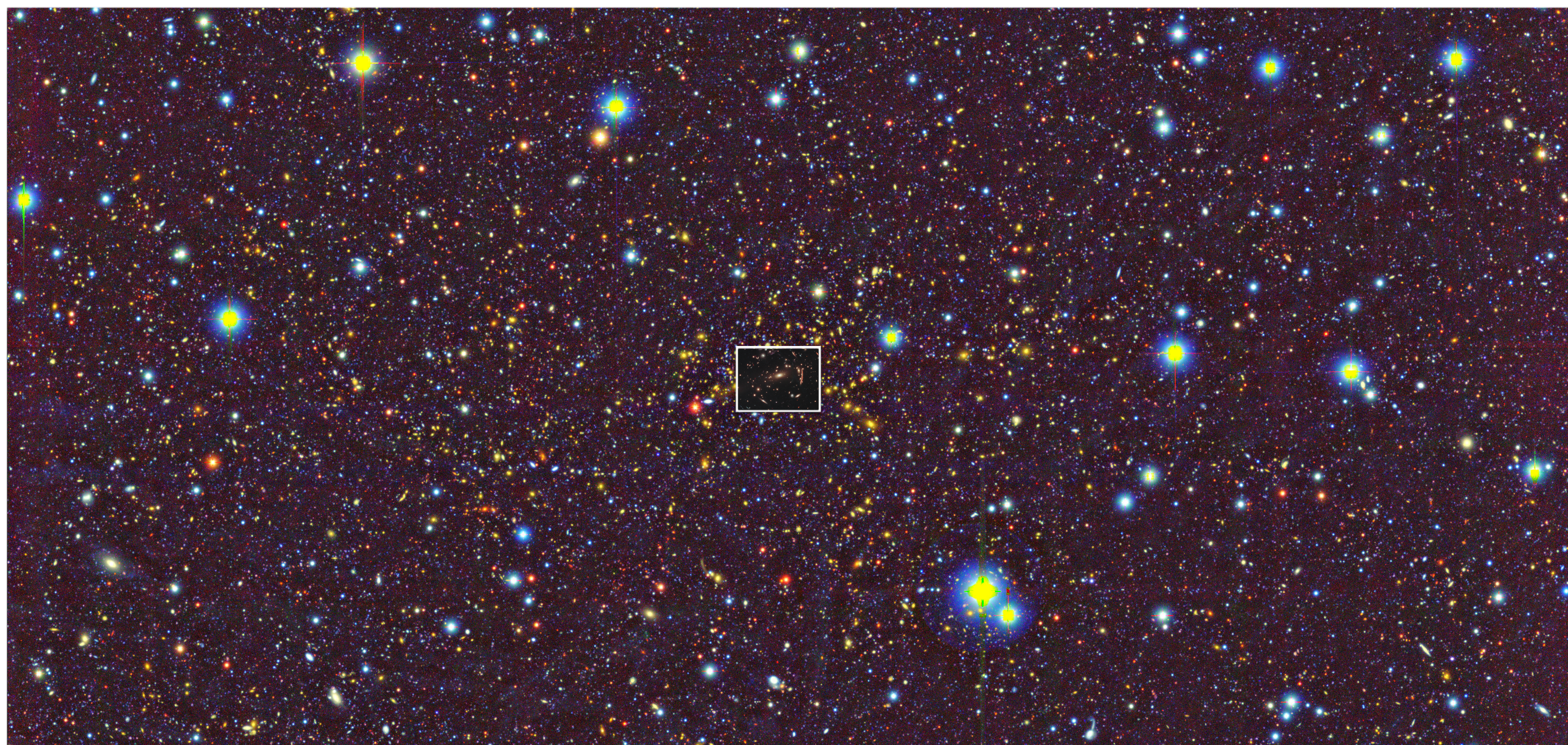


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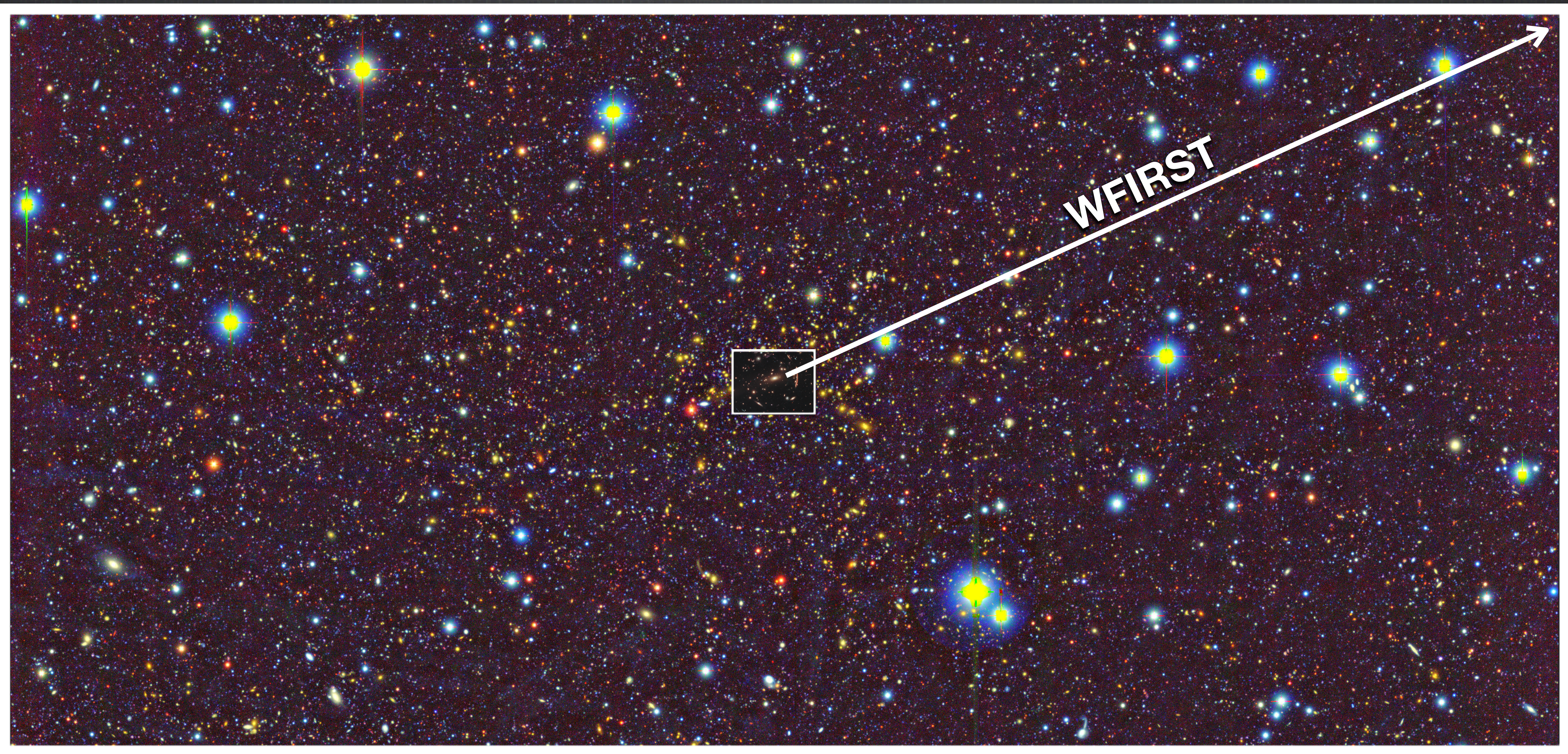


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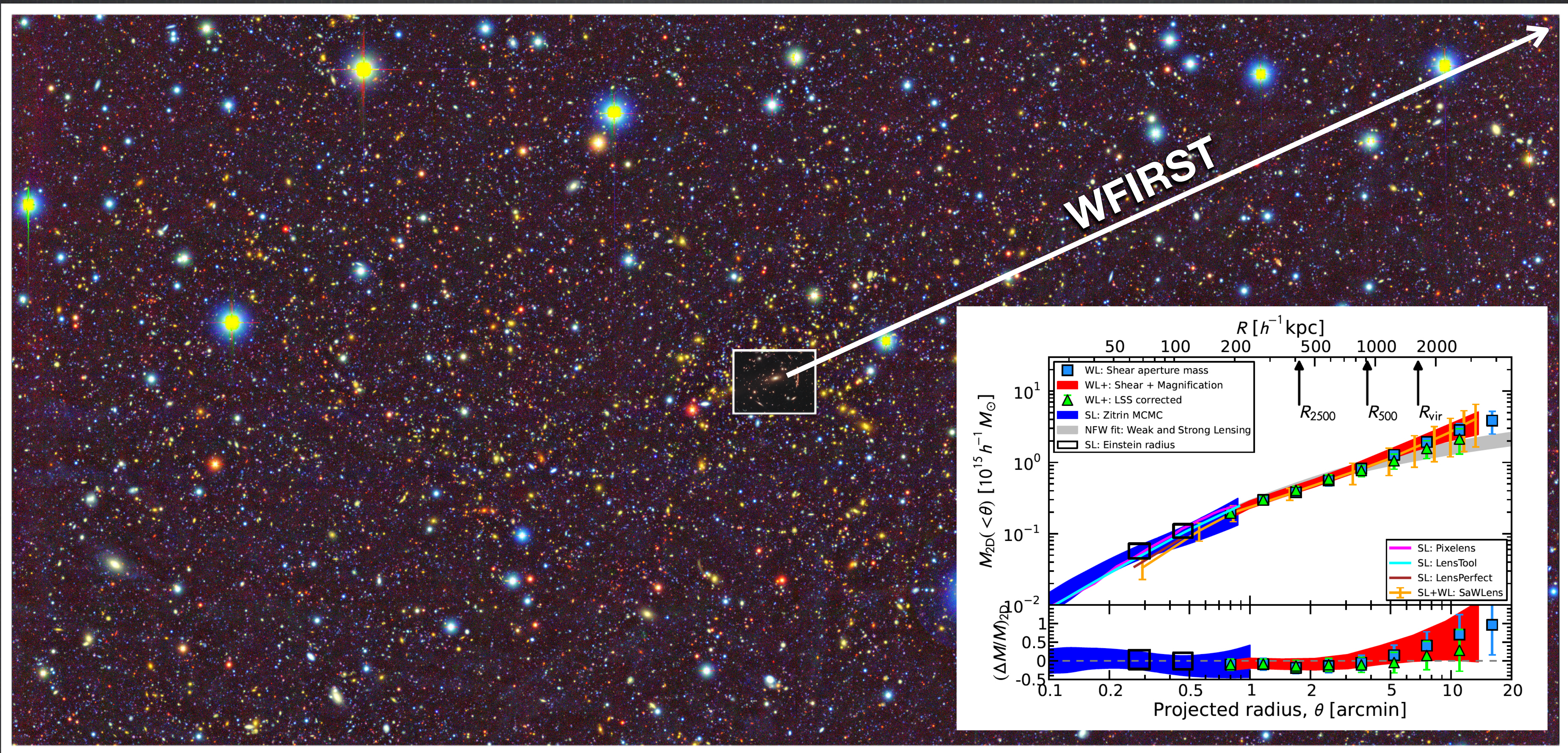


# Gravitational Lensing





# Gravitational Lensing







PHAT (PI - J. Dalcanton)









Image credit: Robert Gendler





Image credit: Robert Gendler



The WFIRST Way



The Hubble Way



Image credit: Robert Gendler



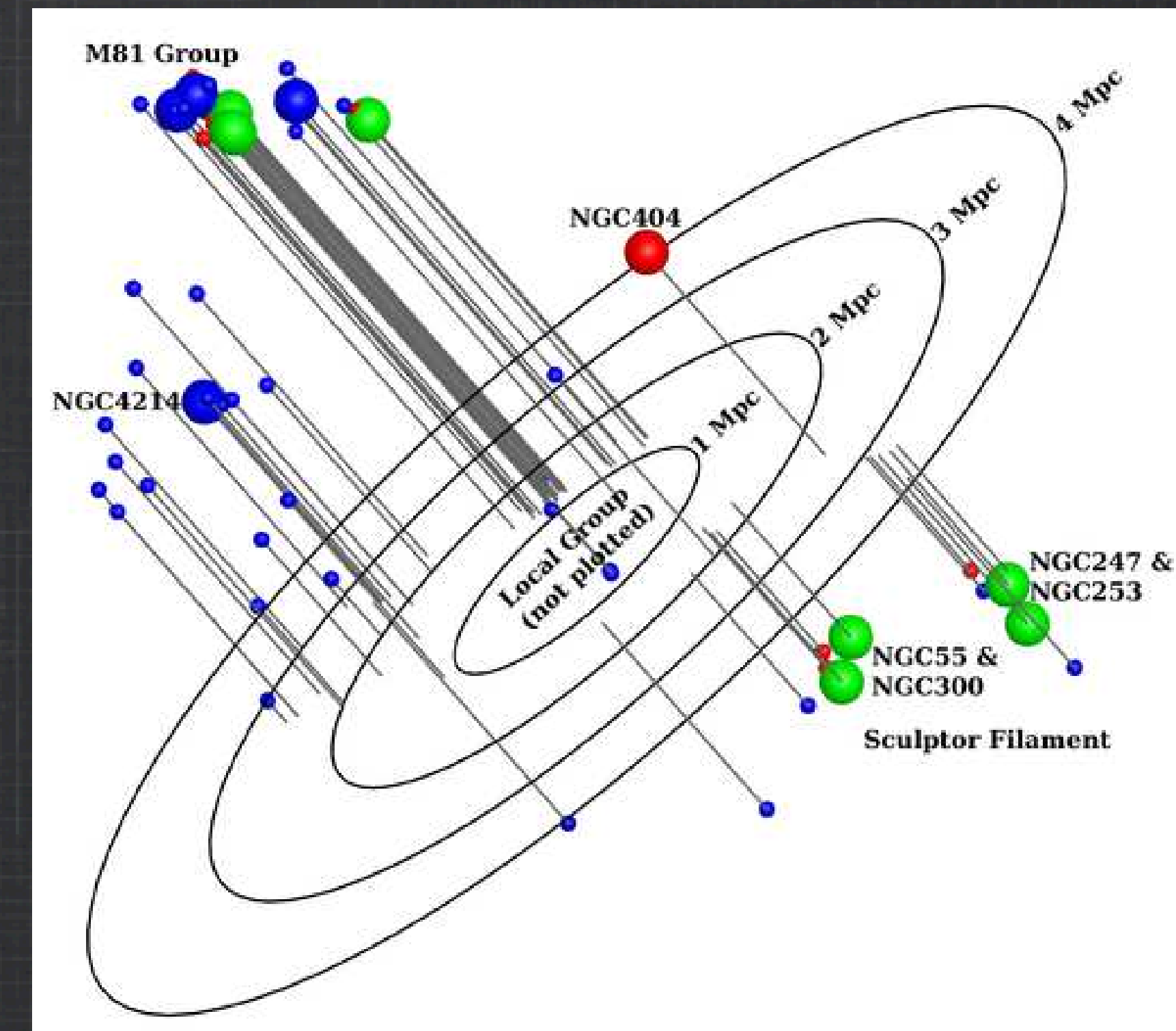
# A WFIRST Treasury GO Program - Dissecting Stellar Halos

## Stellar Halos

- ★ Imaging stellar halos provided detailed insights on  
SB profiles, chemical abundance gradients, stellar ages  
Level of substructure and dSph distribution
- ★ Test cosmological models of galaxy formation on small scales (high res tests currently limited to MW and M31)
- ★ Current surveys (SINGS, SAGE, ANGST, PHAT) severely limited in surveying stellar halos at high resolution

Spitzer SINGS - 75 nearby galaxies  
Spitzer SAGE - LMC and SMC  
Hubble ANGST - 69 nearby galaxies ( $d < 4$  Mpc)  
Hubble PHAT - 1/4 of M31 disk

Sensitivity is 1000s for  $J = 27$





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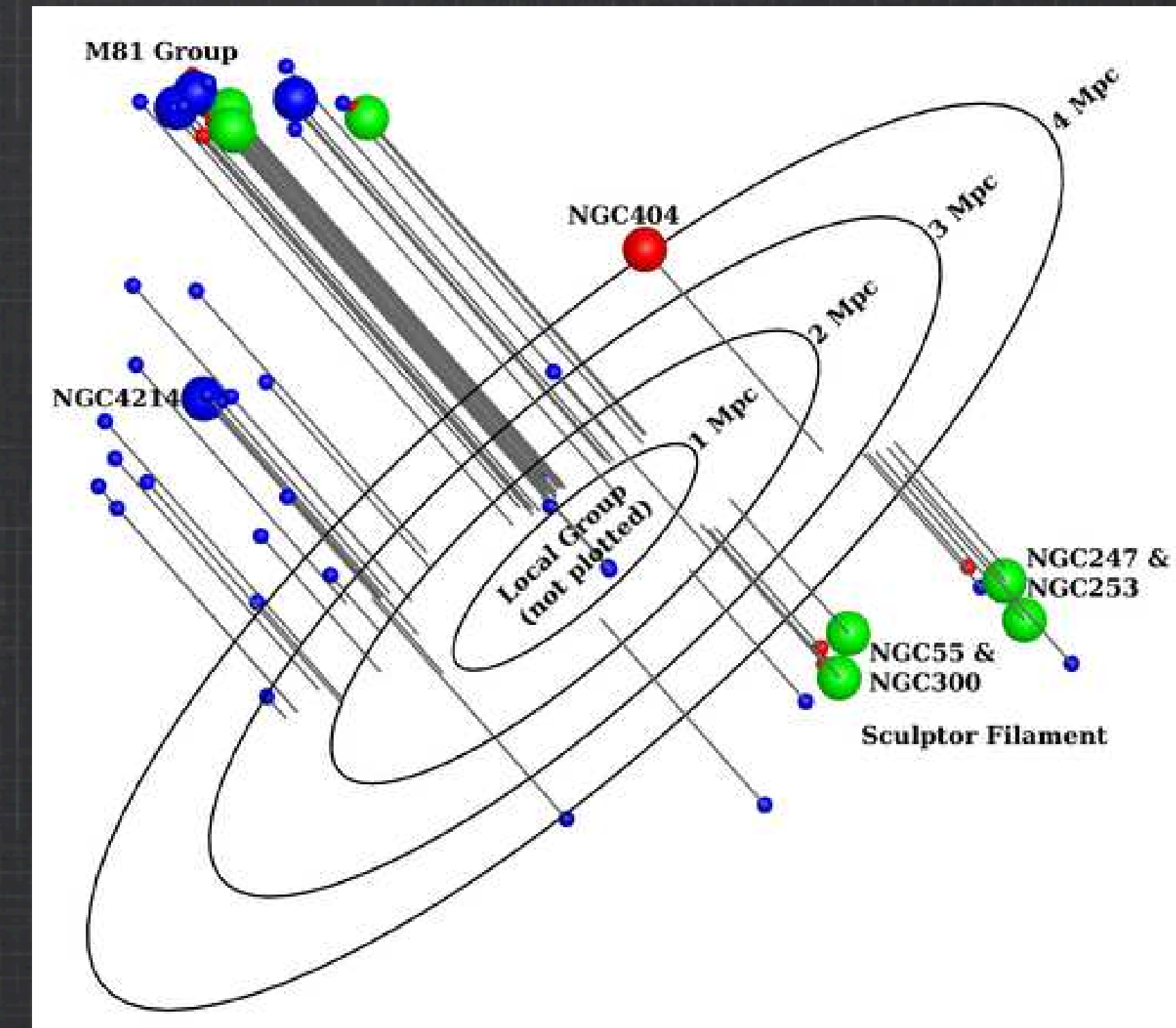
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## Observing Parameters

- ★ MS turnoff at  $M_J = 3.0$ ; RG clump (HB) =  $M_J = -0.7$ ; TRGB at  $M_J = -4.5$
- ★ WFIRST sensitivity -  $J = 26$  in 200s;  $J = 28$  in  $< 2$  hours
- ★ 50 kpc at 10 Mpc = 0.3 deg





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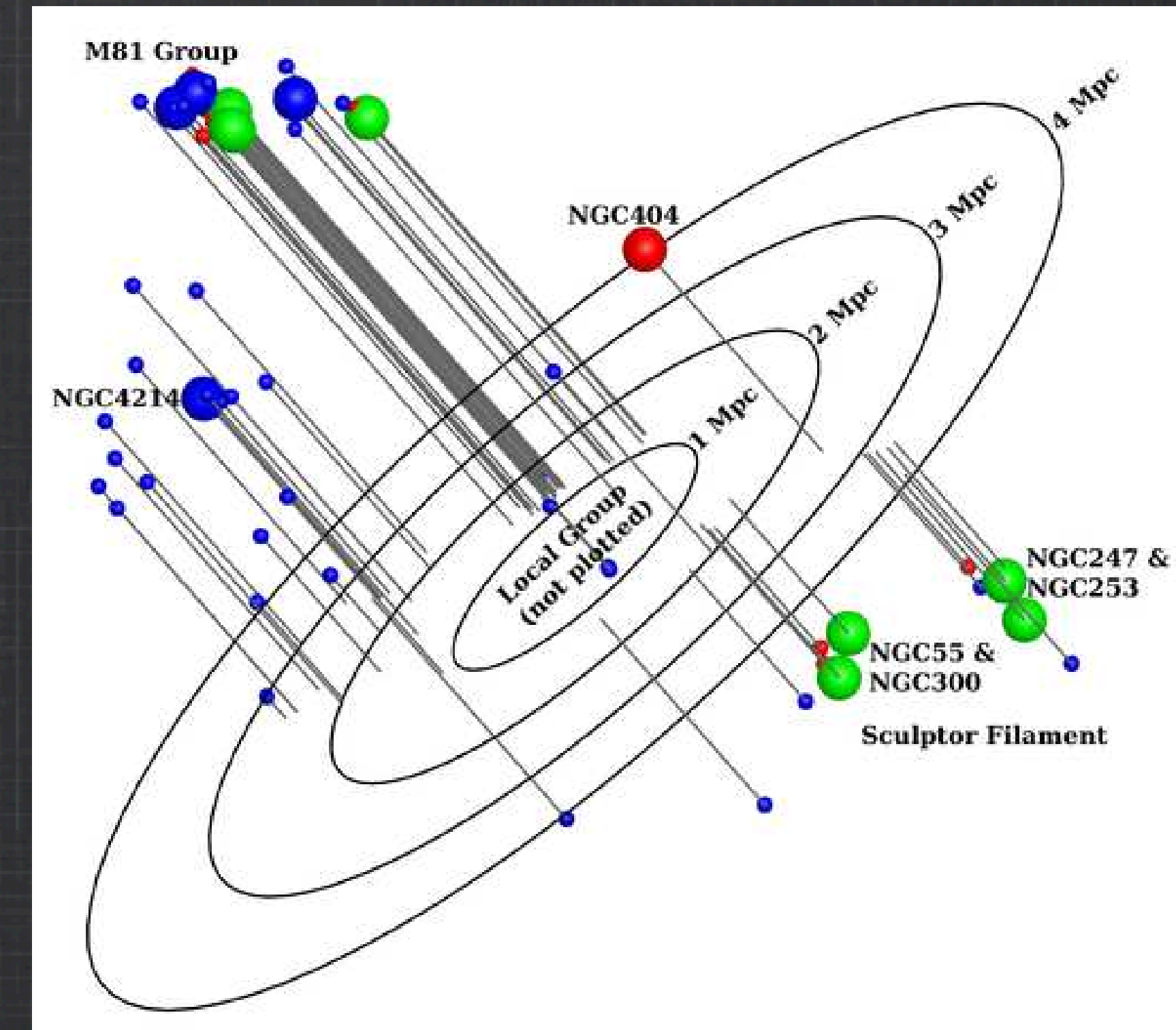
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## WFIRST Efficiency

- ★  $d = 10$  Mpc - single pointing covers the entire stellar halo  
( $J = 28$  is 2.5 mag below TRGB)
- ★  $d = 5$  Mpc - a few pointings cover the entire stellar halo  
( $J = 28$  reaches the RG clump)
- ★  $d = 1$  Mpc - 10 pointings cover the entire stellar halo  
( $J = 26$  reaches 1.5 mag below the RG clump)





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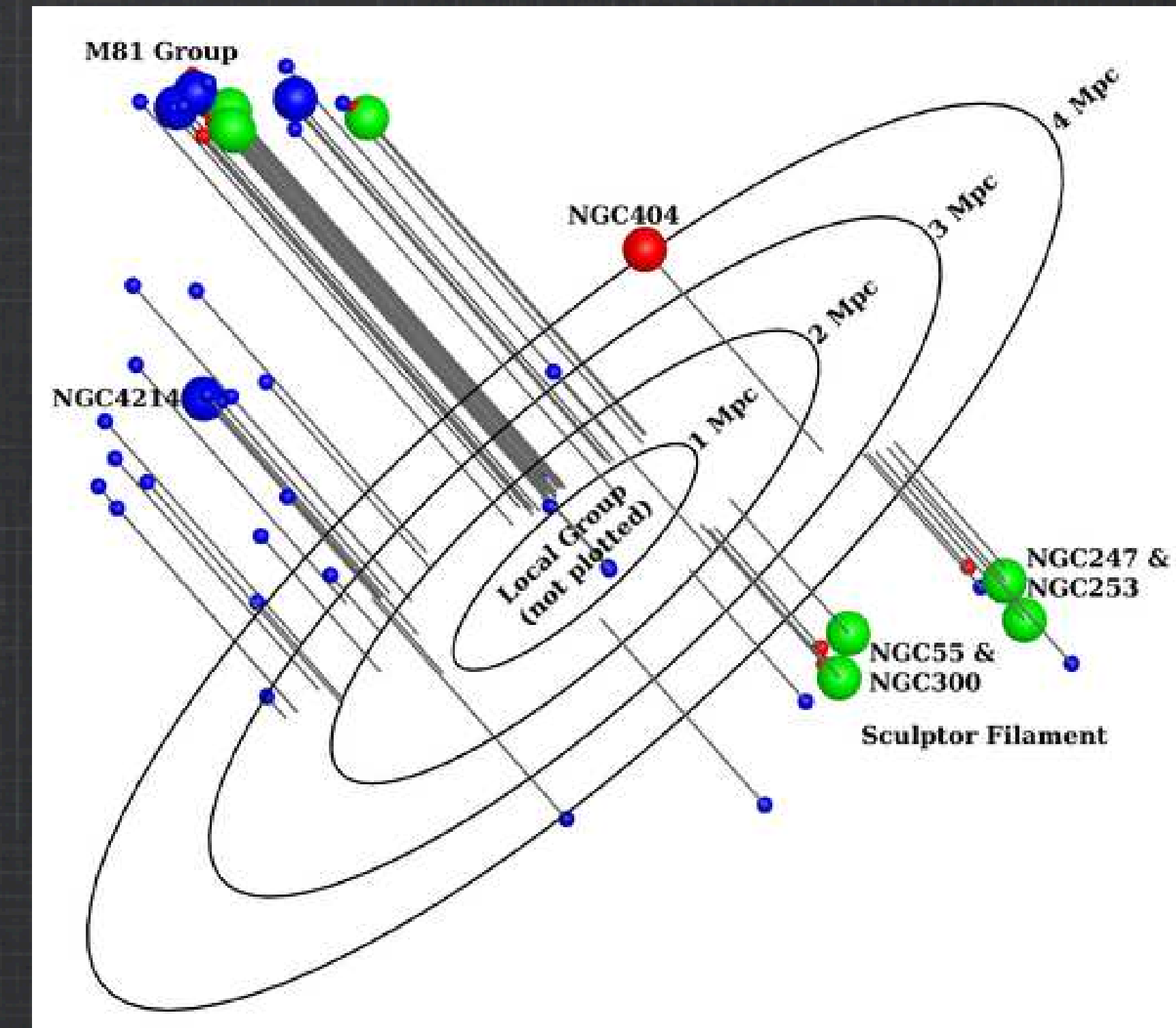
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**A 500 hr GO program would survey the full halos of 100 galaxies**





# Other (Resolved) Guest Observer Opportunities w/ WFIRST

Community 1 Page Science Programs				
Solar System / Exoplanets	GI (HLS)	GI (SN)	GI (ML)	GO
Shlichting - Survey of KBOs				X
Ardila – Free Floating Planets				X
Holman - Transit Timing Variations				X
Grillmair – Exoplanet Spectroscopy				X
Tanner – Exoplanet Transits			X	
Tanner – Exoplanet Astrometry			X	
Stellar Astrophysics				
Tanner – Coldest Brown Dwarfs				X
Kalirai – Stellar Fossils in the MW	X			X
Kalirai - IR Color-Magnitude				X
Ardila – Closest Young Stars				X
Martinache - Low Mass Stars			X	X
Sahu – NSs and BHs			X	
Gaudi – Bulge Parallaxes			X	

Community 1 Page Science Programs				
Galactic / Local Volume Astrophys.	GI (HLS)	GI (SN)	GI (ML)	GO
Stern – LMC Proper Motion			X	X
Besla – Counterpart of the Mag Stream				X
Geha – Faintest Milky Way Satellites	X			X
Deason – Mass of the Milky Way	X			
Strigari – Cold vs Warm Dark Matter				X
Johnston – Finding/Losing Missing Satellites	X			X
Johnston – Potential of the Milky Way	X			X
van der Marel –Nearby Galaxy Halos				X
Guhathakurta – Extragalactic Halo Ages				X
Laine – Substructure in Nearby Galaxies				X
Dalcanton – Resolved Stellar Populations				X
Abraham - Resolving ICL in Virgo				X